

B. Tech. Degree
MECHANICAL ENGINEERING

SYLLABUS FOR CREDIT BASED CURRICULUM
(For Students Admitted in 2011 – 2012)



DEPARTMENT OF MECHANICAL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI - 620 015
INDIA

MAY 2011

DEPARTMENT OF MECHANICAL ENGINEERING

B.Tech. SYLLABUS (revised)

For the Students Joining III Semester in 2011 - 2012

The total credits required for completing the B.Tech. Programme in Mechanical Engineering is 180.

SEMESTER III

CODE	COURSE OF STUDY	L	T	P	C
MA211	Special Functions and Statistics	3	0	0	3
EE223	Applied Electrical Engineering	2	0	2	3
EC217	Applied Electronics Engineering	2	0	2	3
PR221	Production Technology - I	3	0	0	3
CE281	Strength of Materials	3	0	0	3
ME203	Engineering Thermodynamics	3	1	0	4
Practical					
CE283	Strength of Materials Lab	0	0	2	1
ME205	Machine Drawing	0	0	6	2
Total		16	1	12	22

SEMESTER IV

CODE	COURSE OF STUDY	L	T	P	C
MA208	Fourier Series and Partial Differential Equations	3	0	0	3
MT252	Engineering Metallurgy	3	0	0	3
PR222	Production Technology - II	3	0	0	3
ME202	Thermal Engineering	3	0	0	3
ME204	Mechanics of Machines - I	3	1	0	4
ME206	Fluid Mechanics	3	1	0	4
Practical					
CE290	Fluid Mechanics Lab	0	0	2	1
MT262	Metallurgy Lab	0	0	2	1
PR232	Production Process Lab	0	0	3	2
ME208	Thermal Engineering Lab - I	0	0	3	2
Total		18	2	10	26

SEMESTER V

CODE	COURSE OF STUDY	L	T	P	C
MA301	Numerical Methods	3	0	0	3
ME 315	Mechatronics	3	0	0	3
ME 301	Compressible Flow and Jet Propulsion	3	0	0	3
ME 303	Heat and Mass Transfer	3	0	0	3
ME 305	Mechanics of Machines - II	3	1	0	4
ME 307	Analysis and Design of Machine Components	3	0	0	3
Practical					
IC 317	Mechatronics Lab	0	0	2	1
ME309	Dynamics Lab	0	0	3	2
ME 311	Production Drawing and Cost Estimation	1	0	2	2
Total		19	1	7	24

SEMESTER VI

CODE	COURSE OF STUDY	L	T	P	C
ME302	Turbomachines	3	0	0	3
ME304	Automobile Engineering	3	0	0	3
ME306	Design of Mechanical Drives	3	0	0	3
ME308	Computer Aided Design and Drafting	3	0	0	3
ME310	Refrigeration and Air Conditioning	3	0	0	3
ME3E1	Elective – I	3	0	0	3
Practical					
ME312	Thermal Engineering Lab II	0	0	3	2
ME314	Automobile Engineering Lab	0	0	3	2
ME316	Computer Aided Design and Drafting Practice	0	0	2	1
Total		18	0	8	23

SEMESTER VII

CODE	COURSE OF STUDY	L	T	P	C
HM401	Industrial Economics	3	0	0	3
ME403	Power Plant Engineering	3	0	0	3
ME405	Metrology and Quality Control	3	0	0	3
ME407	Oil Hydraulics and Pneumatics	3	0	0	3
ME4E2	Elective – II	3	0	0	3
ME4E3	Elective – III	3	0	0	3
Practical					
ME409	Metrology Lab	0	0	2	1
ME411	Comprehensive Viva-voce	0	3	0	3
ME413	Project Work Phase – I	0	1	0	0
Total		18	4	2	22

SEMESTER VIII

CODE	COURSE OF STUDY	L	T	P	C
HM402	Management Principles and Concepts	3	0	0	3
PR472	Resource Management Techniques	3	0	0	3
ME4E4	Elective – IV	3	0	0	3
ME4E5	Elective – V	3	0	0	3
ME410	Project Work Phase – II	0	0	15	6
Total		12	0	15	18

Credits for I Year	- 45
Credits for Mechanical Engineering (III to VIII Semester)	- 135
Total Credits	- 180

LIST OF ELECTIVES

Elective – I:

SEMESTER VI

CODE	COURSE OF STUDY	L	T	P	C
ME352	Finite Element Method	3	0	0	3
ME354	Advanced I.C. Engines	3	0	0	3

Elective – II & III:

SEMESTER VII

CODE	COURSE OF STUDY	L	T	P	C
ME451	Industrial Safety	3	0	0	3
ME453	Optimization in Engineering Design	3	0	0	3
ME455	Computational Fluid Dynamics	3	0	0	3
ME457	Design of Gears and Cams	3	0	0	3
ME 459	MEMS Devices – Design and Fabrication	3	0	0	3
ME461	Welding Engineering	3	0	0	3
HM401	Corporate Communication	3	0	0	3
	(or)				
	Any one Elective from other Departments				

Elective – IV & V:

SEMESTER VIII

CODE	COURSE OF STUDY	L	T	P	C
ME452	Industrial Robotics	3	0	0	3
ME454	Combustion Engineering	3	0	0	3
ME456	Dynamics of Machinery	3	0	0	3
ME458	Renewable Energy	3	0	0	3
ME460	Advanced Machining Processes	3	0	0	3
	(or)				
	Any one Elective from other Departments				

SEMESTER III

MA211 SPECIAL FUNCTIONS AND STATISTICS (3 – 0 – 0) 3

Laplace Transforms of standard functions – Unit Step function, Dirac delta, function, derivatives and integrals - Inverse Laplace Transform - convolution theorem – Periodic functions - Application to ordinary differential equations and simultaneous equations with constant coefficients and integral equations.

Gamma and Beta functions - Forbenius method of finding series solution of ordinary differential equation.

Bessel's equation – Bessel functions - Recurrence formulae - Orthogonality property- Generating function. Legendre's equation- Legendre polynomials - Rodrigue's formula- Orthogonality property - Generating function - Recurrence relations.

Probability - conditional probability - Bayes' theorem – Random variable – density and distribution functions – Expectation - Binomial, Poisson and Normal distributions.

Moment generating function - Characteristic function – Chebyshev's inequality - Law of large numbers - Central Limit Theorem.

References:

1. Grewal, B.S., *Higher Engineering Mathematics*, Khanna Publishers, 6th ed. 2001.
2. Gupta, S.C., and Kapoor, V.K., *Fundamentals of Mathematical Statistics*, Sultan Chand and Sons, 2002.
3. Venkataraman, M. K., *Higher Mathematics for Engineering and Science*, National Publishing Company, 1997.

EE223 APPLIED ELECTRICAL ENGINEERING (2 – 0 – 2) 3

Asynchronous Machines: Three phase induction motors – Principle of operation – Cage and Slip ring rotors.

Torque – Slip Characteristics - Equivalent Circuit – Starting and Speed Control.

Single Phase induction motors – Types – Applications – Universal Motor.

Selection of Drives: Electric drives – Individual and Group drives – Factors governing selection of drives – Motors for domestic uses.

Cranes, Lifts, General Factory, Textile Mill, Paper Mill, Mining Work, Cement Mill, Machine Tools, Belt Conveyors, Ships, Refrigeration and Air Conditioning.

References:

1. Theraja, B.L., *Electrical Technology*, Vol – 2, S. Chand & Company, 1997.
2. Gupta, J.B., *A Course in Electrical Power*, S.K. Kataria & Sons, 1997.

3. Hughes, E., *Electrical Technology*, E.L.B.S. 1996.
4. Partab, H., *Art & Science of utilization of Electrical Energy*, Dhanpat Rai & Sons, 1997.

EC217 APPLIED ELECTRONICS ENGINEERING (2 – 0 – 2) 3

Amplifier circuits – R.C. Coupled, Transformer Coupled, Direct Coupled; Differential amplifiers.

Concept of negative feed-back; Feed-back amplifiers. Applications of operational amplifiers.

Inverting and non-inverting amplifiers; Differentiator – Multiplier - Divider, Comparator - VI and IV converter.

Digital Circuits – D/A and A/D – Types; Sample and Hold circuit - Multiplexers, Demultiplexers, Decoder and Encoders.

Practice on R.C. Coupled amplifier, OP amp, Multiplexers and Demultiplexers, SCR and Applications, Power supply and Regulator.

References:

1. Sedra, A.S. and Smith, K.C., *Micro Electronic Circuits*, Oxford University Press, 2004.
2. Millman and Halkias, *Integrated Electronics*, Tata McGraw -Hill, 1998.
3. Donald A. Neamen, *Electronic Circuit Analysis and Design*, Tata McGraw- Hill, 2002.

PR221 PRODUCTION TECHNOLOGY – I (3 – 0 – 0) 3

Moulding sands - Types and Properties, patterns - types of patterns, selection of patterns - pattern allowances - Classifications of castings - according to mould materials and moulding methods. Special casting techniques - Fettling and finishing of castings - defects in castings.

Classification of welding process: Principle of Gas welding, Arc welding, resistance welding, Solid State Welding, Thermochemical welding and radiant energy welding - Brazing and soldering - thermal cutting of metal/alloys.

Forging: Classification of forging processes - forging processes - forging defects and inspection. Rolling: Classification of rolling processes - rolling mill - rolling of bars and shapes. Extrusion: Classification of extrusion processes - extrusion equipments - examples.

Drawing: Drawing of rods, wires and tubes. Sheet metal forming methods: Shearing, Blanking, Bending, Stretch Forming, deep forming. Spinning: Spinning processes.

High Velocity Forming: Explosive forming, Electro hydraulic forming - magnetic pulse forming - pneumatic - mechanical high velocity forming. Plastics Working: Types of plastics - plastic moulding processes.

References:

1. Jain R.K., *Production Technology*, Khanna Publishers, 2001.

2. Hajra Choudhry, *Elements of Workshop Technology*, Vol – II Media Promoters & Publishers, 1994.
3. *Production Technology by HMT*, Tata McGraw-Hill, 2002.
4. Chapman, W.A.J., *Workshop Technology*, Vol - II, Oxford & IBH Publishing Co. Ltd., 1986.

CE281 STRENGTH OF MATERIALS (3 - 0 - 0) 3

Axial and shear stresses and strains – Elasticity, Hook’s law – Lateral strain – Poisson’s ratio – Volumetric strain – Elastic constants – Stress in composite bars. Strain energy impact and suddenly applied loads.

Thin cylindrical and spherical shells subjected to internal pressure. Principal stresses and their planes. Plane of maximum shear – Mohr’s circle of stresses. Thick cylinders – Lamé’s equation, shrink fit. Compound cylinders.

Shear force and bending moment diagrams for beams subjected to different types of loads – Theory of simple bending and assumptions.

Leaf spring, shear stress. Deflection – The moment area method, Macaulay’s method – superposition (statically determinate beams only).

Torsion of solid and hollow circular shafts – Power transmission, strength and stiffness of shafts. Stress and deflection in open helical spring.

References:

1. Timoshenko, S.P., Gere, M.J., *Mechanics of Materials*, C.B.S., Publishers, 1980.
2. Ramamurtham, S., *Strength of Materials*, Dhanpat Rai Publications, 2005.
3. Popov, E.P., *Engineering Mechanics of Solids*, Prentice-Hall, 1999.

ME203 ENGINEERING THERMODYNAMICS (3-1-0) 4

Review of basic concepts of thermodynamics, properties of pure substances - First law applied to control mass, control volumes. First law of thermodynamics steady flow energy equation - applications of SFEE - uniform state, uniform flow.

Second law statements - irreversible processes, Carnot theorem, Clausius Inequality — entropy, entropy change for pure substances – T-S diagram, entropy change applied to control mass, control volume-availability and irreversibility.

Vapour power cycles - Rankine cycle - Effect of pressure and temperature on rankine cycle - Reheat cycle - Regenerative cycle - Air standard power cycles - Assumptions regarding air standard cycles - Otto , Diesel , dual , Stirling and Brayton cycles.

Thermodynamic relations : Partial derivatives - Maxwell relations - Clapeyron equation, entropy of a pure substance - entropy change of an ideal gas - the ideal gas - Behavior of real gases - equations of state. Isothermal and adiabatic compressibility.

Mixture of non-reacting gases - Dalton's and Amalgam's model - calculation of C_p , C_v , R and U , h and s changes for gas mixtures fuels and combustion - combustion chemistry - calculation of air fuel ratio - exhaust gas analysis.

References:

1. Sonntag, R.E., Borgnakke, C., and Van Wylen, G.J., *Fundamentals of Thermodynamics*, 6th ed., John Wiley, 2003.
2. Cengel, Y.A and Boles, M.A, *Thermodynamics: An Engineering Approach*, 5th ed., McGraw-Hill, 2006.
3. Nag, P.K., *Engineering Thermodynamics*, 3rd ed., Tata McGraw-Hill, 2005.

CE283 STRENGTH OF MATERIALS LAB (0 – 0 – 2) 1

Deflection test on springs, steel bar, cantilever beams, wooden beams.

Torsion test on different grades of steel.

Hardness test.

Impact test.

ME205 MACHINE DRAWING (0 - 0 - 6) 2

Standardization - Interchangeability - Selective Assembly - Tolerance. Tolerance of form and position - grades of tolerance - fits -Standard tolerances - Machining symbols - surface finish indication - Functional and manufacturing datum.

Shaft Couplings: rigid, flexible: cotter joints, knuckle joints, Hook's joints. Bearings - Journal - Footstep, thrust or Collar bearing; Plummer block; Pulleys for flat belts, V-belt and rope. Engine parts - Stuffing box, Connecting rod, Atomizer, spark plug, fuel injection pump. Valves - stop valve - safety valve, relief valve and non-return valve. Machine tool components - Drill jig, Tail stock, Toolpost, Tool head for shaping machine, machine vice, screw jack.

References:

1. Dhawan, R.K., *A Text Book of Machine Drawing*, S. Chand & Company, 1996.
2. Ostrowsky, O., *Engineering Drawing with CAD Applications*, ELBS, 1995.
3. Engineering Drawing Practice for Schools and Colleges SP: 46- 1988.

SEMESTER IV

MA208 FOURIER SERIES AND PARTIAL DIFFERENTIAL EQUATIONS (3 – 0 – 0) 3

Dirichlet conditions - Expansion of periodic functions into Fourier series - Change of interval-Fourier series for even and odd functions - Half-range expansions- RMS value of a function - Parseval's relation - Fourier series in complex form - Harmonic analysis.

Definition of Fourier Transform (finite and infinite) - Inverse Fourier Transform –Properties - Fourier Sine and Cosine transforms - Inverse Fourier Sine and Cosine transforms – Properties - Convolution theorem for Fourier Transform.

Formation of PDE - Solution of standard types of first order equations - Lagrange's linear equation - Second and higher order homogeneous and non-homogeneous linear equations with constant coefficients.

One-dimensional wave equation and one-dimensional heat flow equation - method of separation of variables - Fourier series solution.

Two-dimensional heat flow equation in steady state - Laplace equation in Cartesian and polar co ordinates - method of separation of variables - Fourier series solution.

References:

1. Grewal, B.S., *Higher Engineering Mathematics*, Khanna Publishers, 2001.
2. Kandasamy, P. Thilagavathy, K. and Gunavathy, K., *Engineering Mathematics*, Vol. III, S. Chand & Co, 2001.
3. Venkataraman, M. K., *Engineering Mathematics*, Vol.III, National Publishing Company, 1998.

MT252 ENGINEERING METALLURGY (3 – 0 – 0) 3

Atomic Arrangement and Phase Diagrams - Structure of metals and alloys: Phase diagram: phase rules.

Phase Diagrams and Ferrous Alloys Fe- FeC diagram, Critical temperature - Plain carbon steel and other steels. .

Heat Treatment of steel, CCT diagrams, austempering, martempering ausforming. Surface hardening process - non - ferrous alloys.

Testing of Materials I - Properties evaluated by tensile testing procedure, Engineering stress strain curve vs. true stress-strain curve, stress strain curve for typical materials. Hardness testing.

Testing of Materials II - Impact testing, Fracture toughness. Fatigue testing: Creep testing.

References:

1. Avner, S.H., *Introduction to Physical Metallurgy*, 2nd ed., Tata McGraw-Hill, 1997.
2. Dieter, G.E., *Mechanical Metallurgy*, McGraw-Hill, 1988.
3. Donald S.Clark, and Wilbur R. Varney, *Physical Metallurgy for Engineers*, East-West Press, 1999.
4. Suriyanarayana, A.V.K, *Testing of metallic materials*, Tata McGraw-Hill, 2001.

PR222 PRODUCTION TECHNOLOGY – II (3 – 0 – 0) 3

Lathes, capstan & turret lathe, drilling and boring machine -Classification - principles of working components, work holding & tool holding devices.

Shaper, planner & slotter, machines - Classification - principles of working components, work holding & tool holding devices.

Milling, hobbing, broaching & grinding machines - Classification - principles of working components, work holding & tool holding devices.

NC & CNC machine tools and manual part programming Machining centre, turning centre. NC part programming.

Computer aided part programming - APP: Post processors. APT programming - motion statements, additional apt statements.

References:

1. Khanna, O.P., and Lal, M., *A Text Book of Production Technology*, Vol II , Dhanpat Rai & Sons, 1992.
2. Yoram Koren, *Computer Control of Manufacturing Systems*, McGraw-Hill, 1986.
3. Choudhry, S.K.H., *Elements of Work Shop Technology*, VoL II, Media Promoters & Publishers, 1994.
4. *Production Technology by HMT*, Tata McGraw-Hill, 2002.
5. Kundra, T.K., Rao., P.N., and Tiwari, N.L.K., *Numerical Control and Computer Aided Manufacturing*, Tata McGraw-Hill, 2006.

ME202 THERMAL ENGINEERING (3 – 0 – 0) 3

Reciprocating air compressors - types - construction - work of compression without clearance - effect of clearance – Multistaging - optimum intermediate pressure for perfect inter cooling - Compressor efficiencies and mean effective pressure.

Working of two and four stroke engines - valve and port timing diagrams - Deviation of engine indicator diagram from air standard cycles - Fuel air cycles and their analysis, Comparison of air standard and fuel air cycles - Losses in actual cycles.

I.C. engines fuels and rating -SI engine air fuel mixture requirements - Performance curve of an automobile carburetor - Diesel injection systems - types - Jerk type pump - Injection pump governors. Types of nozzles - Introduction to petrol injection.

Battery Ignition - magneto ignition and transistorized coil ignition - Combustion in SI engines - Knock in SI engines - effect of engine variable on knock - Combustion in CI engines - knock in CI engines - combustion chambers for SI and CI engines.

I.C. Engine testing - Measurement of friction power - Indicated power - Electronic Indicator- Brake power - dynamometers - Instruments for measuring emission of NO_x , CO, Unburnt HC and smoke - engine efficiencies - Heat balance - Scavenging in two stroke engines.

References:

1. Ganesan, V., *Internal Combustion Engines*, Tata McGraw-Hill, 2003.
2. Heywood, J.B., *Fundamentals of Internal Combustion Engines*, McGraw-Hill, 1988.
3. Ballaney, P.L., *Thermal Engineering*, Khanna Publishers, 1996.

ME204 MECHANICS OF MACHINES I (3 - 1 - 0) 4

Mechanisms - classification of mechanisms, Kinematic inversions - Grashoff's law - Inversions of slider crank mechanism, Coupler curves, spatial mechanisms - Straight-line generators.

Slider crank mechanisms and four bar mechanism; Velocities of points on a rigid body - relative velocity - velocity polygon Acceleration of points on a rigid body - relative acceleration - acceleration polygon - Coriolis acceleration - analytical method .

Chebyshev spacing for precision positions - Structural error - Overlay method - Complex curve synthesis - Roberts Chebyshev theorem - Frudenstine's equation; Analytical synthesis using complex algebra; synthesis of dwell mechanism.

Classification of cam and follower - displacement diagrams - Graphical layouts of cam profiles. Derivatives of follower motion. High speed cams standard motions. Plate cams with flat face and roller followers.

Terminology and definitions - law of gearing - profile for gears - Involute gearing - Interchangeability - Interference and undercutting. Contact ratio. Standard and stub gear teeth. Contact ratio. Gear trains - types - Parallel axis gear trains. Epicyclic gear trains.

References:

1. Uicker, J. J., Jr., Pennock, G. R., and Shigley, J. E., *Theory of Machines and Mechanisms*, 3rd ed., Oxford University Press, 2003.
2. Rao, J.S. and Dukkipati, R.Y., *Mechanism and Machine Theory*, 2nd ed., Wiley Eastern Ltd., 1995.

ME206 FLUID MECHANICS (3-1-0) 4

Basic concepts - Fluid properties - Basic hydrostatic equation - Manometry - Submerged and floating bodies.

Pressure at a point - Hydrostatic equations for incompressible and compressible fluids - Manometers - Hydrostatic force on a submerged plane and curved surfaces - Buoyancy and equilibrium of floating bodies - Metacentre - Fluid in rigid motion bodies.

Fluid dynamics; integral and differential formulations - Continuity equation - Navier-Stokes equations.

Laminar and turbulent flows - Some exact solutions of Navier-Stokes equations - Flow through pipes.

Fluid rotation and deformation - Stream function - Condition of irrotationality - Governing equations of potential flow - Laplace equation. Boundary layer concept - Prandtl's equation - Drag on flat plates - Buckingham π -theorem - Dimensionless numbers.

References:

1. Fox, R.W. and Mc Donald, A.T., *Introduction to Fluid Mechanics*, 6th ed., John Wiley, 2003.
2. White, F.M., *Fluid Mechanics*, 5th ed., McGraw-Hill, 2003.

CE 290 FLUID MECHANICS LAB (0 – 0 – 2) 1

Determination of pipe friction.
Calibration of venturimeter, orifice meter and water meter.
Determination of discharge coefficients for notches and weirs.
Determination of minor losses.
Determination of discharge coefficients for mouthpiece and orifice.
Flow through helical coils.
Determination of metacentric height.

MT 262 METALLURGY LAB (0 – 0 – 2) 1

Preparation of specimen for metallographic observation of white Cast Iron, Gray Cast Iron, Nodular Iron.

Preparation of specimen for metallographic observation of Mild Steel, Low Carbon Steel, Medium Carbon Steel, Hypereutectoid Steel, Hardened Steel, Tempered Steel, Tool Steel and Stainless steel.

Preparation of specimen for metallographic observation of Al – Si Alloys, Al – bronze Alloy, Pb – Tin soldering alloy, Pb – Tin antimony Alloy.

Tensile, Hardness and Creep testing of given metallic materials.

PR232 PRODUCTION PROCESS LAB (0 – 0 –3) 2

Lathe – Simple / Step / Taper Turning, Thread Cutting, Drilling and Boring.
Shaping – V – Cutting
Milling – Job requiring Indexing.
Hobbing – Spur Gear Cutting
Grinding – Surface / Cylindrical grinding
CNC Lathe – Simple Turing, Step Turning, Thread Turing
Machining Center – A typical job production.

ME208 THERMAL ENGINEERING LAB I (0 - 0 - 3) 2

Property determination for fuels and lubrication oil.
Study and performance testing of IC engines.
Study and performance testing of air compressor.
Emission measurements.

SEMESTER V

MA 301 NUMERICAL METHODS (3 – 0 – 0) 3

Solution of linear system - Gaussian elimination and Gauss-Jordan methods - LU - decomposition methods - Crout's method - Jacobi and Gauss-Seidel iterative methods - sufficient conditions for convergence - Power method to find the dominant eigenvalue and eigenvector.

Solution of nonlinear equation - Bisection method - Secant method - Regula falsi method - Newton- Raphson method for $f(x) = 0$ and for $f(x,y) = 0, g(x,y) = 0$ - Order of convergence - Horner's method - Graeffe's method - Bairstow's method.

Newton's forward, backward and divided difference interpolation – Lagrange's interpolation – Numerical Differentiation and Integration – Trapezoidal rule – Simpson's 1/3 and 3/8 rules - Curve fitting - Method of least squares and group averages.

Numerical Solution of Ordinary Differential Equations- Euler's method - Euler's modified method - Taylor's method and Runge-Kutta method for simultaneous equations and 2nd order equations - Multistep methods - Milne's and Adams' methods.

Numerical solution of Laplace equation and Poisson equation by Liebmann's method - solution of one dimensional heat flow equation - Bender - Schmidt recurrence relation - Crank - Nicolson method - Solution of one dimensional wave equation.

References:

1. Gerald, C.F., and Wheatley, P.O., *Applied Numerical Analysis*, Addison Wesley, 1998.
2. Jain, M.K., Iyengar, S.R. and Jain, R.K., *Numerical Methods for Scientific and Engineering Computation*, Wiley Eastern, 1987.
3. Kandasamy, P., Thilagavathy, K., and Gunavathy, S., *Numerical Methods*, S.Chand & Company, 1998.

ME315 MECHATRONICS (3 – 0 – 0) 3

INTRODUCTION

Introduction to Mechantronics-Systems-Measurement Systems-Control Systems-Mechatronics Approach.

SENSORS AND TRANSDUCERS

Introduction-Performance, Terminology-Displacement, Position and Proximity-Velocity and Motion-Fluid Pressure-Temperature Sensors-Light Sensors-Selection of Sensors-Signal Processing.

8085 MICROPROCESSOR

Introduction-Architecture-Pin Configuration-Instruction set-Programming of Microprocessors using 8085 instructions-Interfacing input and output devices-Interfacing D/A converters and A/D converters-Applications- Temperature control-Stepper motor control-Traffic light controller.

PROGRAMMABLE LOGIC CONTROLLERS

Introduction-Basic structure-Input/Output Processing-Programming-Mnemonics-Timers, Internal relays and counters-Data handling-Analog Input/Output-Selection of a PLC.

DESIGN AND MECHATRONICS

Stages in Designing mechatronic systems - Traditional and Mechatronic design -Possible design solutions-Case studies of mechatronic systems - Pick and place robot - automatic car park system -engine management system.

References:

1. *W.Bolton, Mechatronics,Longman,Second Edition, 1999.*
2. *Michael B. Histan and David G.Alciatore, " Introduction to Mechatronics and Measurement Systems ", McGraw Hill International Editions, 1999.*
3. *HMT Ltd., " Mechatronics ", Tata McGraw Hill Publishing Co. Ltd., 1998.*
4. *Dan Neculescu, "Mechatronics",Pearson Education Asia,2002(Indian reprint).*

ME301 COMPRESSIBLE FLOW AND JET PROPULSION (3 - 0 - 0) 3

Governing equations for inviscid-compressible flows - static and stagnation properties - speed of sound and Mach number.

Isentropic flow through variable area passage ducts - Choking of flow.
Normal and oblique shocks - Prandtl-Meyer flows.

Fanno flow - Rayleigh flow.

Fundamentals of jet propulsion - Propulsion cycle - Power and efficiency calculations - Turbojet, turbofan, and turboprop engines - Fundamentals of rocket propulsion.

References:

1. Yahya, S.M., *Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion*, 3rd ed., New Age International Publishers, 2003.
2. Oosthuizen, P.H. and Carscallen, W.E., *Compressible Fluid Flow*, McGraw-Hill, 1997.
3. Zucker, R.D. and Biblarz, O., *Fundamentals of Gas Dynamics*, 2nd ed., John Wiley, 2002.

ME303 HEAT AND MASS TRANSFER (3-0-0) 3

Conduction - General 3-D equation - Heat generation problems - Fins - Unsteady state conduction.

Radiation Laws - Black and Gray bodies - Radiation exchange between surfaces - Radiation shields Green house effect.

Forced Convection - Boundary layer theory - External and internal flows - Free convection - Correlations.

Heat exchangers - Fouling factor, LMTD and NTU methods - Boiling and condensation - Boiling regimes and correlations, Nusselt's theory - Condensation over surfaces.

Mass transfer - Fick's law - Similarities between heat and mass transfer.

References:

1. Incropera, F.P. and Dewitt, D.P., *Fundamentals of Heat and Mass Transfer*, 5th ed., John Wiley, 2002.
2. Holman, J.P., *Heat Transfer*, 9th ed., Tata McGraw-Hill, 2004.
3. Ozisik, M.N., *Heat Transfer - A Basic Approach*, McGraw-Hill, 1985.
4. Cengel, Y.A., *Heat Transfer - A Practical Approach*, McGraw-Hill, 1998.

ME305 MECHANICS OF MACHINES - II (3-1-0) 4

Static and dynamic force analysis of mechanisms - Flywheel function and design.

Balancing of rotating masses in one and in several planes - Balancing of reciprocating masses – Single and multi-cylinder engines.

Governors; gravity and spring controlled governors - Gyroscopic effect.

Vibration; free and forced vibrations - Single degree and multi-degree freedom systems.

Vibration control - Passive and active control.

References:

1. Shigley, J.E., Uicker, J.J., *Theory of Machines and Mechanisms*, McGraw-Hill, 1995.
2. Rao, J.S., and Dukkupati, R.Y., *Mechanism and Machine Theory*, 2nd ed., Wiley Eastern Ltd., 1995.

ME307 ANALYSIS AND DESIGN OF MACHINE COMPONENTS (3 - 0 - 0) 3

Mechanical engineering design - Design considerations - Material selection - Modes of

failure - Theories of failure - Endurance limit - Stress concentration - Factor of safety.

Design of shafts and couplings - Design of cotter and knuckle joints.

Helical and leaf springs.

Fasteners and keys - Design of welded joints - Fillet and butt welds - Design of riveted joints.

Design of sliding contact bearings - Selection of rolling contact bearings.

References:

1. Sundararamoorthy, T.V. and Shanmugam, N., *Machine Design*, Anuradha Agencies, 2003.
2. Shigley, J.E., Charles, R.M. and Richard, G.B., *Mechanical Engineering Design*, 7th ed., McGraw-Hill, 2004.

IC 317 MECHATRONICS LAB (0 – 0 – 2) 1

Verification of basic specifications of operation amplifier from data sheet; OP-amp Ck1 amplifier (inverting and Non-inverting)

P-amp Ck2 wave form generation (square wave, triangular wave); OP-amp Ck3 Integrator, Differentiator; OP-amp Ck4 V-I converter & I-V converter.

Study of transducers: RTD + Signal Conditioning Circuit; Study of LVDT with accessory chip; Study of Digital Gates - SOP realization.

Study of Microprocessor instruction set; Simple programs using 8085 microprocessor - Addition, Use of functions, Peripheral chips, Waveform generation.

Usage of interrupts, Stepper motor control, Key board interface, Heater control; Study of PLC; Study of tools such as PSPICE; Usage of simulators (any other microprocessor)

ME309 DYNAMICS LAB (0 - 0 - 3) 2

Measurement of moment of inertia of rigid bodies.

Gyroscope.

Jump speed of a cam.

Mechanical vibrations.

Balancing.

ME 311 PRODUCTION DRAWING AND COST ESTIMATION (1 – 0 – 2) 2

Conventional Representation of Machine elements - International Standards (ISD) and Indian Standards (IS).

Limits and Fits - IT system of tolerances, deviations and fits.

Geometric Dimensioning and Representation - Tolerancing, Tolerancing of form, orientation, location and run-outs, Datums and Datum Systems.

Surface texture indication on drawing. Welds - Symbolic representing of drawings. Preparation of process - Chart for a given component.

Cost Estimation of setting time and machining time - estimation of material cost, labour cost and overhead cost based on supplied data. Given a sub-assembly /assembly to prepare production drawings of components as per current drawing office practice. At least ten sub-assemblies/assemblies are to be completed on A4 sheets.

References:

1. Indian Standards : 10714,10715,10716,10717,10719, 813,919,2709,8000 , pt.1 to 4 : 10721, 11158 corresponding to ISO's
2. *PSG Design Data Book*, PSG Book Depot, 2010.
3. Khan M.Y. & Jain P.K., *Cost Management*, TMH outline series, 2nd ed., 2000.
4. *Engineering Drawing Practice for Schools and Colleges SP: 46- 1988.*

SEMESTER VI

ME302 TURBOMACHINES (3 - 0 - 0) 3

Introduction - Classification - Dimensional analysis - Specific speed - Basic laws and equations.

Hydraulic turbines; Pelton, Francis, and Kaplan turbines - Turbine efficiencies - Cavitation in turbines.

Centrifugal pumps; theory, components, and characteristics - Cavitation - Axial flow pumps - Pump system matching.

Centrifugal and axial flow compressors; slip, surging and chocking.

Steam turbines; basic cycle, impulse and reaction turbines - Gas turbine; basic cycle and multi-staging - Power and efficiency calculations.

References:

1. Dixon, S.L., *Fluid Mechanics and Thermodynamics of Turbomachines*, 5th ed., Butterworth-Heinemann, 2005.
2. Sayers, A.T., *Hydraulic and Compressible Flow Turbomachines*, CBLs, 2003.
3. Ganesan, V., *Gas Turbines*, 2nd ed., Tata McGraw-Hill, 2003.
4. Lakshminarayana, B., *Fluid Dynamics and Heat Transfer of Turbomachinery*, Wiley-Interscience, 1995.

ME304 AUTOMOBILE ENGINEERING (3 - 0 - 0) 3

General classification of vehicles - Power unit - All components of power unit.

Steering systems - Power steering - Wheel and suspension systems - Transmission system; clutches, couplings, gear boxes, and torque converters.

Axles - Differentials - Mechanical, hydraulic, and pneumatic brakes - Power brakes - Four wheel drive.

Electrical systems; construction, operation, and maintenance of batteries - Starter motors.

Lighting and electrical accessories - Panel board instruments - Automobile air conditioning - Troubleshooting.

References:

1. Heitner, J. *Automotive Mechanics Principle and Practice*, 2nd ed., Affiliated East-West Press Ltd., 1974.
2. Newton, K., Steeds, W., and Garrett, T.K., *The Motor Vehicle*, Butterworths, 1989.
3. Kirpal Singh, *Automotive Engineering*, Vol. I & II, Standard Publishers, New Delhi, 2002.

ME306 DESIGN OF MECHANICAL DRIVES (3 - 0 - 0) 3

Introduction to transmission elements - Positive and friction based drives.

Importance of friction based drives - Design of flat and V-belts - Design of rope and chain drives.

Design of spur and helical gears based on contact and beam strength.

Design of bevel and worm gears.

Design of multi-speed gearbox - Preparation of ray diagram and kinematic arrangement diagram for multi-speed gearbox.

References:

1. Sundararajamoorthy, T.V. and Shanmugam, N., *Machine Design*, Anuradha Agencies, 2003.
2. Shigley, J.E., *Mechanical Engineering Design*, 5th ed., McGraw-Hill, 1989.
3. *PSG Design Data Book*, PSG Book Depot, 2010.

ME308 COMPUTER AIDED DESIGN AND DRAFTING (3 - 0 - 0) 3

CAD hardware - Product cycle - CAD tools, CAD systems; system evaluation, CAD specific I/O devices.

CAD software - Graphic standards – Modes of graphics operation, Software Modules.

Geometric modeling – Types and mathematical representation and manipulation of curves and surfaces.

Solid modeling- fundamentals, feature based modeling manipulations of solid models.

Transformation of Geometric models and visual realism - Animation.

References:

1. Zeid, I., *CAD/CAM Theory and Practice*, Tata McGraw-Hill, 2008.
2. Rogers, D.E and Adams, J.A., *Mathematical Elements for Computer Graphics*, 2nd ed., McGraw-Hill, 1990.

ME310 REFRIGERATION AND AIR CONDITIONING (3 - 0 - 0) 3

Introduction about Refrigeration – Definitions of various terms. Methods of refrigeration. Air refrigeration system. Bell – Coleman cycle. Introduction about Air craft Air-Conditioning.

Analysis of Vapour compression cycle, Modifications to basic cycle. Multi pressure systems. Multi-evaporator system and Cascade systems. Properties of refrigerants. Selection of refrigerants.

Discussion of components of V.C system, Servicing. Vacuumizing and charging of refrigerant. Introduction to cryogenics.

Psychrometry – Definitions for properties. Introduction to cooling load calculations. Comfort conditions. Effective temperature concept.

Air-conditioning systems – discussion about the central plant with direct evaporator and chiller applications, Ice plant, refrigerators. Food preservation, IQF technique and freeze drying etc. Cold storage and thermal insulation.

References:

1. Manohar Prasad, *Refrigeration and Air Conditioning*, New Age International, 2004.
2. Dossat R.D., *Principle of Refrigeration*, 4th ed., Prentice-Hall, 1997.
3. Arora, C.P., *Refrigeration and Air Conditioning*, 2nd ed., Tata McGraw-Hill, 2000.

ME312 THERMAL ENGINEERING LAB - II (0 - 0 - 3) 2

Study and performance tests on refrigeration.

Study and performance tests on air conditioning test rig.

Heat transfer experiments based on conduction and convection.

Heat transfer experiments based on radiation.

ME314 AUTOMOBILE ENGINEERING LAB (0 - 0 - 3) 2

Study on engine components.
Fuel systems.
Ignition systems - Transmission systems - Steering systems.
Suspension and braking systems.
Layout of electrical wiring - Light and heavy vehicles.

ME316 COMPUTER AIDED DESIGN AND DRAFTING PRACTICE (0 - 0 - 2) 1

Components drawing with dimensioning
Assembly drawing using modeling software package
Shaft coupling
Bearings
Automobile parts
Machine tool parts

SEMESTER VII

HM 401 INDUSTRIAL ECONOMICS (3 – 0 – 0) 3

Demand and Supply – Forecasting techniques – Cost and Revenues.

Competitive nature of the firms – Keynesian economics – National income.

Trade cycle – Inflation – Index numbers – Capital budgeting – Cash flow analysis – Balance sheet.

Risk and Decision Making – Technological Change in Global Economy – Locating the Firm in a global economy – Taxes and Decision Making.

Exchange Rate determination – Marketing – Product life cycle – Marketing research – Branding – Personality – Motivation – Leadership – Working in Teams.

References:

1. Adhikary Manab, *Business Economics*, Excel Books, 2004.
2. Dwivedi, D.N., *Macro Economics Theory & Policy*, Tata Mc Graw-Hill, 2005.
3. Aczel D. Amir, Soundarapandian Jayavel, *Complete Business Statistics*, Tata Mc Graw-Hill, 2005.
4. Robins P. Stephen, *Organizational Behaviour*, Prentice-Hall, 2002.

ME403 POWER PLANT ENGINEERING (3 - 0 - 0) 3

Layout - various components and functions of thermal power plants.
Nuclear power plants and gas turbine.
Hydro power plants.
Diesel power plants.
Power plant economics and environmental hazards.

References:

1. Culp Jr., A.W., *Principles of Energy Conversion*, McGraw-Hill, 1985.
2. Arora, S.C. and Domkundwar, S., *A Course in Power Plant Engineering*, Dhanpat Rai & Sons, 2001.
3. El Wakil, M.M., *Power Plant Technology*, Tata McGraw-Hill, 1985.
4. Nag. P.K., *Power Plant Engineering*, 2nd ed., Tata McGraw-Hill, 2002.

ME405 METROLOGY AND QUALITY CONTROL (3 - 0 - 0) 3

Standards - Errors in measurements - Calibration - Length measurements. Angle measurements. Limits and tolerances.

Surface finish; terminology and measurements - Optical measuring instruments.

Measurement of screw thread and gear elements - Acceptance test for machines.

Statistical Quality Control - Control charts - Sampling plans.

References:

1. Gupta, I.C., *Engineering Metrology*, Dhanpat Rai & Sons, 2004.
2. Grant, E.L., *Statistical Quality Control*, Mc Graw-Hill, 2004.
3. Doebelin E.O., *Measurement Systems*, Mc Graw-Hill, 2004.

ME407 OIL HYDRAULICS AND PNEUMATICS (3 - 0 - 0) 3

Basic concepts of fluid power system design - Hydraulic oils and fluid properties – Seals and Seal materials - Filters and Filtration.

Hydraulic pumps, cylinders, and motors - Construction, sizing, and selection.

Control valves; pressure, flow, and direction - Servo-valves.

Basic hydraulic circuits, hydrostatic transmission - Cartridge valve circuits.

Control of hydraulic circuits - Electrical, electronics, and PLC - Pneumatic components and basic circuits.

References:

1. Esposito. A., *Fluid Power with Applications*, 5th ed., Pearson Education, 2003.
2. *Industrial Hydraulics*, Vickers - Sperry Manual, 2002.

ME409 METROLOGY LAB (0 - 0 - 2) 1

Measurements on precision instruments; sine bar, CMM - Universal measuring microscope, Profile projector - Electronic comparator, optical flat, surface roughness - Gear tooth thickness - MAAG gear tester - Calibration of LVDT - Statistical Quality Control charts.

ME411 COMPREHENSIVE VIVO-VOCE (0 - 3 - 0) 3

ME413 PROJECT WORK - PHASE I (0 - 1 - 0) 0

SEMESTER VIII

HM402 MANAGEMENT PRINCIPLES AND CONCEPTS (3 – 0 – 0) 3

Introduction to management –Evolution of scientific management, modern management, Principles- Elements of management planning, organizing, staffing, directing, coordinating, reporting, budgeting.

Financial management, objectives, scope, Techniques of investment analysis, Payback period, sources of financing, technology management, product design, and plant layout.

Inventory management, project management, PERT, CPM- Applications.

Significance of Human resources management, HR Planning, Job evaluation, recruitment and selection.

Placement and induction, training, Performance appraisal, compensation, Industrial relations.

References:

1. Prasad, L.M., *Principles and practice of Management*, Sultan Chand & Sons, 2006.
2. Gupta, R.N., *Principles of Management*, Sultan Chand & Co, 2001.

PR472 RESOURCE MANAGEMENT TECHNIQUES (3 – 0 – 0) 3

Linear programming, graphical method - simplex method - big M method - Two-phase method - introduction to duality theory

Transportation & assignment models -Mathematical model for Transportation problem – balanced and unbalanced problem –Assignment problem.

Queuing theory & sequencing - applications of queuing model -single and multi server model.

Decision theory and replacement analysis.

Project scheduling -project network - determination of critical path, project duration and slack time calculation - Cost considerations in project scheduling.

References:

1. Gupta and Hira, *Problems on operations research*, S.Chand & Company, New Delhi, 1991.
2. Taha H.A., *Operations research*, Prentice – Hall of India, New Delhi, 2001.
3. Panneerselvam, R, *Operations Research*, Prentice – Hall of India, New Delhi, 2002

LIST OF ELECTIVES

SEMESTER VI

Elective I

ME352 FINITE ELEMENT METHOD (3 - 0 - 0) 3

Introduction - Illustration using spring systems and simple problems - Weighted residual methods Galerkin's method - Variational approach - Rayleigh-Ritz method.

One-dimensional finite element analysis; bar element, beam element, frame element - Heat transfer problems.

Two-dimensional finite element analysis; types of elements, shape functions, natural coordinate systems.

Applications to structural mechanics - Numerical integration - Solution of finite element equations.

Fluid flow problems - Dynamic problems.

References:

1. Seshu, P., *Textbook of Finite Element Analysis*, Prentice-Hall, India, 2003.
2. Segerlind, L.J., *Applied Finite Element Analysis*, John Wiley, 1987.

ME354 ADVANCED IC ENGINES (3 - 0 - 0) 3

Engine design parameters, properties of working fluids.

Analysis of engine cycles, fuel intake systems.

Combustion in SI and CI engines.

Pollutant formation and control in IC engines.

Engine performance and modeling.

References:

1. Heywood, J.B., *Internal Combustion Engine Fundamentals*, McGraw-Hill, 1988.
2. Taylor, C.P., *The Internal Combustion Engines in Theory and Practice*, Vol. II, MIT Press, 1985.
3. Ganesan, V., *Internal Combustion Engines*, 2nd ed., Tata McGraw-Hill, 2003.

SEMESTER VII

Elective – II & III:

ME451 INDUSTRIAL SAFETY (3 - 0 - 0) 3

Evolution of modern safety concept- safety policy - Safety Organization - Safety Committee - budgeting for safety.

Safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign

Concept of an accident, reportable and non reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – cost of accident.

Machine Guarding, Guarding of hazards, Machine Guarding types and its application – Safety in welding and Gas cutting – Safety in Manual and Mechanical material handling- Safety in use of electricity

Toxicity- TLV- Types of Chemical Hazards-Occupational diseases caused by dust, fumes, gases, smoke and solvent hazards- control measures

Fire triangle- Types of fire - first aid firefighting equipment – flammability limit- LPG safety

Overview of factories act 1948 – OHSAS-18000

References:

1. Accident Prevention Manual for Industrial Operations”, N.S.C.Chicago, 1982
2. Blake R.B., “Industrial Safety” Prentice Hall, Inc., New Jersey, 1973
3. Heinrich H.W. “Industrial Accident Prevention” McGraw-Hill Company, New York, 1980.
4. Krishnan N.V. “Safety Management in Industry” Jaico Publishing House, Bombay, 1997.
5. John Ridley, “Safety at Work”, Butterworth & Co., London, 1983.

ME453 OPTIMIZATION IN ENGINEERING DESIGN (3 – 0 – 0) 3

Introduction - Optimization techniques. Single and multi variable optimization. Constrained optimization.

Specialized algorithms - Integer, geometric.

Nontraditional algorithms.

References:

1. Deb, Kalyanmoy, *Optimization for Engineering Design*, Prentice - Hall, 1995.
2. Rao. S.S., *Optimization Theory and Applications*, Wiley Eastern Ltd., 1998.

ME455 COMPUTATIONAL FLUID DYNAMICS (3 - 0 - 0) 3

Classification of partial differential equations - Discretization methods; finite difference and finite volume formulations.

Numerical solution of elliptical equations - Linear system of algebraic equations.

Numerical solution of parabolic equations - Stability analysis.

Numerical solution of hyperbolic equations - Burgers equation.

Incompressible Navier-Stokes equations and algorithms - Basics of grid generation.

References:

1. Tannehill, J.E., Anderson, D.A., and Pletcher, R.H., *Computational Fluid Mechanics and Heat Transfer*, 2nd ed., Taylor & Francis, 1997.
2. Hoffmann, K.A. and Chiang, S.T., *Computational Fluid Dynamics for Engineers*, Engineering Education Systems, 2000.
3. Anderson J.D., *Computational Fluid Dynamics – The basics with applications*, Mc Graw-Hill, 1995.
4. Versteeg, H.K. and Malalasekera, W., *An Introduction to Computational Fluid Dynamics – The finite volume method*, Longman Scientific & Technical, 1995.
5. Patankar, S.V., *Numerical Heat Transfer & Fluid Flow*, Hemisphere, 1980.

ME457 DESIGN OF GEARS AND CAMS (3 - 0 - 0) 3

Design of gears - spur, helical, bevel and worm & worm wheel.

BIS standards for gear design.

Force analysis.

Design of cams - Tangential and Polynomial cams.

References:

1. BIS Standards.
2. Maitra, G.L., *Hand Book of Gear Design*, 2nd ed., Tata McGraw-Hill, 2005.
3. Merritt, H.E., *Gear Engineering*, A. H. Wheeler & Co. Pvt. Ltd., 1984.

ME459 MEMS DEVICES - DESIGN AND FABRICATION (3 – 0 – 0) 3

An overview of microelectromechanical devices and technologies, and an introduction to design and modeling

Standard microelectronic fabrication technologies; bulk micromachining, surface micromachining, bonding technologies, related fabrication methods, and creating process flows.

Mechanical, thermal, electrical, magnetic, optical, and chemical properties of materials

Introduction to lumped modeling of systems and transducers; an overview of system dynamics

MEMS examples, energy methods, the thermal energy domain; modeling dissipative processes, *Fluids and Transport*

Text Book

1. Tai – Ran Hsu, “MEMS& Microsystems Design and Manufacturing”, Tata McGraw-hill Edition, 2006

References

1. Mohamed Gad-el-Hak, “MEMS: Design and Fabrication (Mechanical Engineering)”, CRC; 1 edition, 2005.
2. Marc J. Madou, “Fundamentals of Microfabrication, the science of Miniaturization”, CRC Press Second Edition, 2002.
3. Sami Franssila, “Introduction to Microfabrication”, John Wiley; 1 edition, 2004.
4. John A. Pelesko, David H. Bernstein, “Modeling MEMS and NEMS”, CRC; 1 edition, 2002.

ME461-WELDING ENGINEERING (3 – 0 – 0) 3

Welding Processes - 1 - Gas welding, manual, submerged arc, TIG, MIG welding, plasma arc. Electroslag, electro-gas welding, pressure welding processes - cold and hot pressure welding. resistance, friction and explosive welding. Plastic and ceramic welding.

Welding Processes - 2 Radiant energy and solid phase welding processes and equipment - Beam power control. Laser beam cutting, under water welding. Diffusion welding.

Allied Processes Brazing, Soldering, Cutting, Surfacing Methods - Need, Flame Spraying. Plasma Spraying.

Welding metallurgy - weld thermal cycles and their effects - structural changes in different materials, effect of pre and post heat treatment. Weldability.

Testing And Design of Weldment - Design and quality control of welds. Edge preparation-types of joints, weld symbols. Stresses in butt and fillet welds - weld size calculations. Design for fatigue. Testing - tensile, bend hardness. Impact, notch and fatigue tests. Visual examination - liquid penetration test, magnetic particle examination. Radio graphs, ultrasonic testing. Life assessment of weldments.

References:

1. Jackson, M.D., *Welding Methods and Metallurgy*, Charles Griffin & Company, London, 1967.
2. AWS, American Welding Society, Volume I to V, Miami, 1982.

3. George E. Linnert, *Welding Metallurgy*, GML Publications, South Carolina, U.S.A., 1994.
4. Little LR, *Welding and Welding Technology*. Tata McGraw-Hill, New Delhi, 1980.

HM401 CORPORATE COMMUNICATIONS (3 – 0 – 0) 3

Communication in the corporate world – Communication process – Networks and Channels of communication

Technology for communication – Role of psychology – Motivation - Speech mechanics – Mental process of speaking

Extempore speech practice – Group dynamics – Seminar & Presentation skills and interview strategies

Listening skills & practice – Familiarity to accents and tones – Varieties of Styles & Registers – Mechanics of technical writing – Report & Executive summary

Abstracts, Circulars & Notices – Proposals, Agenda & Minutes – Papers for Presentation – Marketing Language.

References:

1. Simon Sweeney, *English for Business Communication*, Cambridge University Press, 1997.
2. Shiv Khera, *You Can Win*, Macmillan, 1998.
3. June A. Valladares, *The craft of Copywriting*, Response Books, 1998.
4. Matthukutty M. Monippally, *Business Communication Strategies*, Tata McGraw-Hill, 2001.
5. Raymond V.Lesikar & Marie E. Flatley, *Basic Business Communication*, Tata Mc Graw-Hill, 2005.

SEMESTER VIII

Elective IV & V:

ME452 INDUSTRIAL ROBOTICS (3 - 0 - 0) 3

Classification and characteristics

Principles and problems in robot design and control

Transmission system.

Vision system.

Programming and languages.

References:

1. Mair, G.M., *Industrial Robotics*, Prentice-Hall, 1988.
2. Considine, D.M. and Considine, G.D., *Standard Hand Book of industrial Automation*, Chapman and Hall, 1986.
3. Groover, M.P., Weiss, M., Nagel, R.N., and Odrey, N.G., *Industrial Robotics, Technology, Programming, and Applications*, McGraw-Hill, 1995.

ME454 COMBUSTION ENGINEERING (3 - 0 - 0) 3

Combustion of fuels - Combustion equations and air-fuel ratio calculations.

Thermodynamics of combustion - Thermochemistry - Kinetics of combustion.

Laminar and turbulent flames - Quenching, flammability, ignition and flame stabilization.
Combustion in SI and CI engines.

Emission and control methods.

References:

1. Turns, S.R., *An Introduction to Combustion*, 2nd ed., McGraw-Hill, 2000.
2. Glassman, I., *Combustion*, 3rd ed., Academic Press, 1996.
3. Heywood, J.B., *Internal Combustion Engine Fundamentals*, McGraw-Hill, 1988.
4. Mukunda, H.S., *Understanding Combustion*, Macmillan, 1992.

ME456 DYNAMICS OF MACHINERY (3 - 0 - 0) 3

Single degree of freedom systems - Periodic excitations - Impulse response - Virtual work.

Forced vibrations.

Two degree of freedom systems - coupled vibrations.

Vibration of continuous systems.

Wave and Euler equations - Vibration of plates.

References:

1. Rao, J.S. and Gupta, K., *Introductory Course on Theory and Practice of Mechanical Vibration*, New Age International Pvt. Ltd., 2004.
2. Thomson, W.T., *Theory of Vibration with Applications*, CBS Publishers, New Delhi, 1990.

ME458 RENEWABLE ENERGY (3 - 0 - 0) 3

Solar energy - Solar radiation - Heat transfer equations.

Solar thermal energy conversion - Efficiencies - Solar photo voltaic energy.

Bio energy - Conversion - bio degradation - Biogas generation - Fuel properties - Biomass

gasifier.

Wind energy - Data and energy estimation, Conversion - Wind mill - Performance, applications Geothermal.

Tidal energy - Magneto hydrodynamic - Thermionic - Fuel cell.

References:

1. Sukhatme, S.P., *Solar Energy: Principle of Thermal Collection and Storage*, 2nd ed., Tata McGraw Hill, 2000.
2. Rao, S. and Parulekar, R.B., *Energy Technology - Nonconventional, Renewable and Conventional*, Khanna Publishers, 1995.
3. Rai, G.D., *Nonconventional Energy Sources*, Khanna Publishers, 1999.
4. Le Gourieres, D., *Wind Power Plant - Theory and Design*, Pergaman Press, 1982.

ME460 ADVANCED MACHINING PROCESSES (3 – 0 – 0) 3

Non-traditional machining processes – classification.

Chemical and electrochemical processes - material removal - maskants and etchants - types of chemical material removal - application and limitations - Electrochemical material removal.

Thermoelectrical processes - types - electrical discharging machining, electron beam machining, ion beam machining and plasma arc machining.

Mechanical processes - ultrasonic machining abrasive jet machining - abrasive flow machining - water jet cutting.

Special Machining Processes - polygonal turning and drilling deep hole drilling and trepanning - shaped tube electrolytic machining - thread rolling - roller burnishing - electrical discharge wire cutting - thermal deburring - orbital grinding micromachining - Numerical control and automated processes.

References:

1. *Production Technology by HMT*, Tata McGraw Hill, 2002.
2. Wellar, P.C., *Non-Traditional Machining Processes*, SME, Michigan, 1984.
3. Pandey, P.C., *Modern Machining Processes*, Tata McGraw Hill Company, 2004.
4. Serope Kalpakjian, *Manufacturing Processes for Engineering Materials*, 3rd ed., Addison Wesley Publishing Company, 1997.

ME403 POWER PLANT ENGINEERING (3 - 0 - 0) 3

Layout - various components and functions of thermal power plants.

Nuclear power plants and gas turbine.

Hydro power plants.

Diesel power plants.

Power plant economics and environmental hazards.

References:

5. Culp Jr., A.W., *Principles of Energy Conversion*, McGraw-Hill, 1985.
6. Arora, S.C. and Domkundwar, S., *A Course in Power Plant Engineering*, Dhanpat Rai & Sons, 2001.
7. El Wakil, M.M., *Power Plant Technology*, Tata McGraw-Hill, 1985.
8. Nag. P.K., *Power Plant Engineering*, 2nd ed., Tata McGraw-Hill, 2002.

ME303 HEAT AND MASS TRANSFER (3-0-0) 3

Conduction - General 3-D equation - Heat generation problems - Fins - Unsteady state conduction.

Radiation Laws - Black and Gray bodies - Radiation exchange between surfaces - Radiation shields Green house effect.

Forced Convection - Boundary layer theory - External and internal flows - Free convection - Correlations.

Heat exchangers - Fouling factor, LMTD and NTU methods - Boiling and condensation - Boiling regimes and correlations, Nusselt's theory - Condensation over surfaces.

Mass transfer - Fick's law - Similarities between heat and mass transfer.

References:

5. Incropera, F.P. and Dewitt, D.P., *Fundamentals of Heat and Mass Transfer*, 5th ed., John Wiley, 2002.
6. Holman, J.P., *Heat Transfer*, 9th ed., Tata McGraw-Hill, 2004.
7. Ozisik, M.N., *Heat Transfer - A Basic Approach*, McGraw-Hill, 1985.
8. Cengel, Y.A., *Heat Transfer - A Practical Approach*, McGraw-Hill, 1998.